Before the

Federal Communications Commission

Washington, D.C. 20554

In the matter of	)	
Modification of Parts 2 and 15 of the Commission's Rules for unlicensed devices and equipment approval.	)	ET Docket No. 03-201
	)	
	)	

COMMENTS OF INTEL CORPORATION

INTRODUCTION

Intel Corp. (Intel) hereby submits this comment in response to the Notice of Proposed Rulemaking in the above-referenced proceeding. Intel is the world's largest semiconductor manufacturer and a leader in technical innovation. Intel is also a leading manufacturer of communications and networking chips and equipment.

Intel commends the FCC for initiating this important rulemaking. Specifically Intel wishes to comment on the following items: 1. Advanced Antenna Technologies, 2. Replacement Antennas for Unlicensed Devices 6. Part 15 Unlicensed Modular Transmitter Approvals and 7. Improving Sharing in the Unlicensed Bands. In brief Intel recommends:

Regarding Item 1, *Advanced Antenna Technology*:

- While we agree with the need for the FCC to place some boundaries around the beamwidths of these systems, we believe that a minimum BW limitation of 120 degrees is not an optimum approach for all cases.

- We request that these proposals for advanced antenna systems include technologies that employ any digital modulation schemes that comply with the appropriate technical provisions laid out in part 15.247, as well as in part 15.407 of the FCC rules.

- We request the Commission consider seeking comment on potential power relief for systems that increase throughput on a point-to-point basis through multiple spatial channels, by utilizing techniques such as MIMO.

Regarding item 2, *Replacement Antennas for Unlicensed Devices*:

- In addition to the proposed modifications, Intel believes the new flexibility should also be applied to Part 15.407(d) - the integral antenna requirement for UNII devices operating in the 5.15-5.25 GHz frequency band.

Regarding item 6, *Part 15 Unlicensed Modular Transmitter Approvals*:

- Intel supports the Commission's proposal to codify the eight criteria for approving modular transmitters contained in the 2000 *Public Notice.* However, Intel submits the following comments with regard to the Commission's proposed modifications of the Requirements and an additional modification to Requirement #6.

- With regard to Requirement #5 Intel believes that the definition of a fixed "environment" is not necessary, and that the 10 cm proposed at § 15.212 (e) (2) is overly restricted and 30 cm is more realistic.

- With regard to the new Requirement # 9, Intel believes that in addition to having a unique digital key or "Type Number" which allows approved radio front-ends and firmware to recognize each

other, the component on the host system (where the firmware resides) should authenticate the firmware.

- Intel believes that the Commission should modify Requirement # 6 to permit the FCC ID number for the module to be displayed electronically.

Regarding item 7, *Improving Sharing in the Unlicensed Bands*:

- Today's "sharing" allocations are successful because they create a structure of primary and secondary users and give *de facto* control of the secondary use to the owner of the immediate physical area (business, campus, or home).
- At this point spectrum sharing etiquettes have not been shown to be necessary.
- If the FCC attempts to mandate etiquettes, it would likely delay new services and impede innovation

DISCUSSION

ITEM 1. ADVANCED ANTENNA TECHNOLOGY

We agree with the Commission's proposals for addressing advanced antenna applications for unlicensed devices, including sectorized and phased-array systems. The Commission seeks comment regarding the characteristics that a system would need to exhibit in order to be classified as a sectorized or phased array antenna system., specifically the Commission proposes to limit the total simultaneous beamwidth radiating from the antenna structure to 120º, regardless of the number of beams formed.

Intel feels that a minimum BW limitation of 120 degrees may not be an optimum approach for all cases. We request further discussion to determine if there is perhaps a less limiting approach that can still satisfy interference concerns.

We request that these proposals for advanced antenna systems include technologies that employ any digital modulation schemes that comply with the appropriate technical provisions laid out in part 15.247, as well as in part 15.407 of the FCC rules..

Finally, we suggest that the Commission invite comment on potential power relief for systems that increase throughput on a point-to-point basis through multiple spatial channels, by utilizing techniques such as MIMO.

ITEM 2. REPLACEMENT ANTENNAS FOR UNLICENSED DEVICES

Intel supports the Commission's desire to develop more flexible antenna requirements for unlicensed devices. In addition to the proposed modifications, Intel believes the new flexibility should also be applied to Part 15.407(d) - the integral antenna requirement for UNII devices operating in the 5.15-5.25 GHz frequency band.

We believe that this requirement increases the cost to the consumer, and places an unnecessary burden on the manufacturers, especially for devices that are embedded inside a host device. Application of the proposed rule changes to these devices also will maintain the controls necessary to mitigate interference while removing the added cost and burden that result from the "integral" requirement.

ITEM 6: PART 15 UNLICENSED MODULAR TRANSMITTER APPROVALS

Intel supports the Commission's proposal to codify the eight criteria for approving modular transmitters contained in the 2000 *Public Notice.* However, Intel submits the following comments with regard to the Commission's proposed modifications of the Requirements and an additional modification to Requirement #6.

REQUIREMENT #1

We support the Commission's modification clarifying that only the radio front-end of a partitioned modular unit must be shielded and providing that the physical crystal and tuning capacitors can be located external of the shielded radio front end.

REQUIREMENT #2

Intel supports the Commission's modification to allow control information and other data to cross the interface between the firmware and the radio front-end.

REQUIREMENT #5

Intel believes that the definition of a fixed "environment" such as a PDA or laptop, that will subsequently be mandated in re-testing for future changes to the radio front-end or firmware is not necessary. The only requirement should be that the firmware runs unmodified in an implementation. The Commission seeks suggestions regarding the length and type of cable used to connect the components. Intel believes the 10 cm proposed at § 15.212 (e) (2) is overly restricted and believes 30 cm to be more realistic.

NEW REQUIREMENT #9

Intel believes that in addition to having a unique digital key or "Type Number" which allows approved radio front-ends and firmware to recognize each other, the component on the host system (where the firmware resides) should authenticate the firmware. Once authenticated, the firmware needs to validate that the front-end component has an approved type number for use with that firmware. Upon successful completion of that operation, the radio should be permitted to function.

ADDITIONAL MODIFICATION REQUESTED TO REQUIREMENT #6

Finally Intel believes that the Commission should modify Requirement # 6 to permit the FCC ID number for the module to be displayed electronically.

ITEM 7. IMPROVING SHARING IN THE UNLICENSED BANDS

The Commission asks whether a spectrum sharing "etiquette" should be considered for devices that operate on an unlicensed basis. Today's "sharing" allocations are successful because they create a structure of primary and secondary users and give *de facto* control of the secondary use to the owner of the immediate physical area (business, campus, or home). In the latter case the land owner regulates the deployment of unlicensed devices within his control. This approach protects the legitimate interests of the primary user, mitigates contention among secondary users and avoids unnecessary government technical

mandates. At this point spectrum sharing etiquettes have not been shown to be necessary. Moreover, if the FCC attempts to mandate etiquettes, it would likely delay new services and impede innovation.

The combination of low power limits and propagation characteristics in the unlicensed bands that limit the effective range of these devices has created a workable environment. The "tragedy of the commons" problems that might be expected to be created by contending co-equal unlicensed devices have been mitigated. In the case of Wi-Fi deployments, for example, the homeowner or the corporate or campus IT department controls the deployment of most of the contending devices. The property owner, having control of the operation of contending devices in the area of his control, has the incentive and ability to optimize the use of contending unlicensed devices.

Secondary use by unlicensed devices is predicated on non-interfering or negotiated agreement with the primary users. It is far easier to address this situation, then it is to create technical rules for sharing among co-equal secondary users. Also, such an "inter-service" etiquette does not impose unnecessary costs because without it unlicensed devices would not gain use of the spectrum in the first place. For example, the FCC authorized unlicensed use of the 5 GHz band, because DFS and TPC technologies could be employed to allow unlicensed devices to operate without creating interference to military radars. Whenever the relevant DFS detection threshold is met on a particular frequency, the unlicensed device must change frequencies to avoid interfering with military radar.

In contrast, an "intra-service" etiquette would require the FCC to set additional technical mandates that would necessarily favor particular users, services, technologies or companies over others in their use of the unlicensed spectrum. This dynamic would make allocation proceedings much more controversial and likely add substantial delays. Mandating an etiquette would also create a substantial risk of impeding innovation because rule changes might be required—vitiating one of the primary benefits of unlicensed allocations. Such rules could create other distortions. For example, if the Commission were to require unlicensed devices at 5 GHz to monitor the spectrum in which they intend to operate and begin transmission only if no signal above a specified threshold is detected, this would encourage the design of

devices that would "squat" on frequencies foreclosing future unlicensed users. Such a rule would effectively give priority to first users.

Finally, *ex ante* definition of "fair" spectrum use may raise insuperable technical tradeoffs. Because the "Digital Migration" has de-coupled service from transport, there is no longer a fixed "service" (such as voice call) or use that can be "achieved" with some minimum spectrum use. Devices operating in unlicensed spectrum exploit many different technical parameters in their use of spectrum, such as power, bandwidth, time, etc. Attempting to define a transmit power etiquette is particularly problematic. Modern air interfaces maximize bandwidth as a function of S/N, which varies with transmit power. "Range" is no longer a simple fixed parameter: It is a given bandwidth at a certain distance, that is dependent on transmit power. As Intel noted in the recent 5 GHz proceeding:[1]

> TPC is a capability that can achieve, among other things, a reduction in overall emissions, but Intel believes that mandating a fixed trigger mechanism and level could undermine innovation in the air-interfaces employed in wireless devices including 802.11a & b.
>
> Such regulation could reduce spectrum efficiency and potentially increase overall emissions.
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> By adapting the data rate to channel conditions systems can maximize network efficiency by minimizing the time of transmission. Just as wire-line modems adjust their baud rate depending on the quality of the wired-link, today's protocols for wireless data communication employ "multi-rate" schemes to adjust bit rate based on channel conditions. For instance the IEEE 802.11a standard has a range of possible data rates from 6 to 54 Mbps. For 802.11b the set of possible data rates is 1, 2, 5.5, and 11 Mbps.
>
> If the Commission were to mandate a fixed trigger mechanism such as BER, it could adversely impact this capability and reduce spectrum efficiency. While potentially limiting peak power, TPC regulation could raise emissions by requiring devices to operate for longer periods in order to deliver a given body of data. A fixed trigger mechanism could impede innovation, particularly new protocol development and its associated spectrum efficiencies.[2]

At the application layer there will be a myriad of uses of bandwidth. This makes an *ex ante* determination of what a "fair" amount of bandwidth (and therefore spectrum), an insuperable task. In sum, the unique requirements of operation in the unlicensed bands may have constricted a particular application at a given time, but in the end they have fostered great innovation and the development of

[1] In the Matter of Revision of Parts 2 and 15 of the Commission's Rules to Permit Unlicensed National Information Infrastructure (U-NII) devices in the 5 GHz band; ET Docket No. 03-122

[2] See Comments of Intel Corporation at 2

successful industry standards in the area of interference mitigation and avoidance, which have greatly contributed to efficient spectrum use.

While Intel believes the Commission should not propose etiquette rules at this time, it does support eliminating 15.247 (h), because it restricts innovation in spectrum sharing techniques. This rule prohibits "(t)he coordination of frequency hopping systems in any other manner for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters is not permitted." Elimination of this restriction would enable innovation in the area of coexistence.

Respectfully submitted,

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